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LATE NEWS

Energy legislation debate continued during September with efforts to exclude House bill transmission access provisions from the conference committee rewrite. A separate coalition, charging monopoly exploitation, favors tying access to holding-company reform. Separately, the administration and major industry associations oppose shifting hydro licensing authority away from FERC. The House named more than 100 conferees. Congress is targeted to adjourn Oct. 2.

Weather cools '92 summer peak demand

Mark T. Hoske, News Editor

BARRINGTON, IL—Utilities experienced fewer record electric peak demands this summer than in 1991 and showed a rare decline in overall peak load.

Mild weather in many regions seems to be the main reason for the drop, although demand-side management and a slow-growing economy may have contributed.

For the 56 utilities surveyed by EL&P, January-August peaks fell an average of 1.5 percent when compared to their peaks in 1991. In 1992 through August, the peak was 386,201 MW for the sample; during 1991 it was 392,110 MW.

From 1980 to 1991, summer peak load declined only twice, in 1982 and 1989, according to North American Electric Reliability Council (NERC) and Edison Electric Institute (EEI).

NERC predicted a 2-percent gain

NERC's 1992 Summer Assessment predicted a 2-percent gain in U.S. peak demand this summer.

Only 10 utilities of the 56 in the sample set new all-time demand peaks during July and August. Nineteen peaks from July and August 1991 remained all-time records (see chart).

EL&P surveyed more than 50 of the largest (by megawatt-hour sales) investor-owned utilities by telephone Sept. 1-4. The EL&P sample represents about 70 percent of the total 1991 U.S. electric utility industry in peak load throughout all regions (excluding Alaska and Hawaii).

Results show Florida Progress Corp. gained the most in peak demand from 1991 to 1992, more than 15 percent, setting a new all-time peak. (See table of system peaks for the full list.)

Fewer records may depress sales

Setting a new peak demand record doesn't necessarily mean the rest of the season will include strong energy sales, but it can be an indicator for some utilities.

Midwest Resources' John McCarroll said weather recently depressed that utility's peaks, megawatt-hour sales, and bottom line.

"Because of the weather, our second quarter was bad. Now we think our third quarter will be too," McCarroll said, due to continued cool Midwest summer temperatures. "Maybe next year," he added.

Utilities configure their electrical systems to handle anticipated peak demand by adding facilities and/or buying additional power. Influences to peak demand include weather, energy efficiency, customer mix, number of customers, economic growth, air conditioning, electric heating, and natural gas use.

Utilities attention to demand-side and load management also may have reduced the peaks. EL&P's January re-

port on capital spending at electric utilities shows more capital spending in these areas from 1992 to 1995.

Other peak-related news

Other peak-related information follows.

•Tennessee Valley Authority's summer peak was 21,980 MW on July 13, less than the 1991 peak of 22,081 MW on July 22. TVA set an all-time peak of 24,627 MW in December 1989.

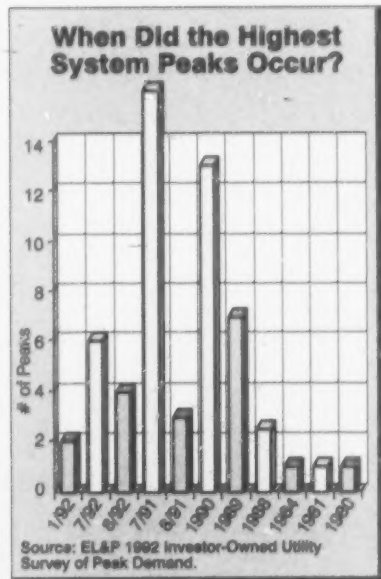
When compared to the largest leading investor-owned utilities, this Knoxville, TN-based federal utility was second only to Southern Co. in all-time peak record.

•New England Power Pool, covering six states, showed a 0.3-percent increase in kilowatt-hour use in 1992 over 1991 through July. Despite the slight gain in amount of electricity used in 1992, NEPOOL's 1991 demand peak still stands, 19,742 MW on July 19.

•New York City, from January to mid-August, had only seven days with temperatures at or above 90°F, compared with an average of 17, according to Pennsylvania State University.

•An air conditioning manufacturing company announced layoffs and plant closings because of low product demand. Sales of seasonal equipment.

Continued on page 2



Source: EL&P 1992 Investor-Owned Utility Survey of Peak Demand.

Presidential candidates' energy views outlined

President George Bush says he's committed to energy issues and the environment and that his record shows it.

Gov. Bill Clinton, the Arkansas democratic challenger, says the administration has done little or nothing in these areas, and that he'd make the U.S. a leader in environmental progress.

The Bush/Quayle ticket:

- Introduced the National Energy Strategy in February 1991. Congress was still working on an energy bill as of mid-September. The NES includes incentives for domestic oil and gas production, promotes energy efficiency, clean coal, and nuclear power. It relies on competition, rather than command-and-control measures, removes regulatory barriers, and invests in research.
- Has at least a dozen initiatives on oil and natural gas, aiming to increase competition and use of natural gas, and decrease oil imports.

- Seeks nuclear energy and coal policies to streamline nuclear licensing, support advanced nuclear reactors (see story this issue), ensure progress on nuclear waste disposal, and demonstrate and export clean coal technologies. Settled questions about power plant modifications and emissions standards with the "WEPCo" rule.
- Encourages renewable energy sources, hydropower, and alternate-fueled vehicles with more than nine specific policy initiatives.
- Promotes energy and economic proficiency in more than eight ways, including requests for added funding, voluntary programs. Signed new laws for greater energy efficiency in new public housing and more mass transit.
- Proposed and signed Clean Air Act Amendments into law.
- Rejects carbon taxes and mandates for CO₂ reductions, instead promoting voluntary programs to limit suspected greenhouse gases. Accelerated CFC cuts.

had a national energy policy.

- Would promote national security, energy diversity, economic prosperity and environmental protection by increasing energy efficiency, conservation, natural gas use, renewable energy resources, and opposing increased reliance on nuclear power.
- Promotes utility regulatory changes to make energy efficiency profitable for utilities and customers.
- Strengthens federal programs to improve energy efficient housing and encourage state and local governments to stiffen related building codes. They would also increase vehicle fuel standards by as much as 64 percent to 45 mpg. Standards would insure that federal grants, contracts and projects support national conservation goals.
- Would increase use of natural gas in all sectors, speed development of new pipelines, switch the federal fleet to natural gas and spend federal money to develop new natural gas applications.
- Hope to give utilities least-cost planning incentives, create a civilian renewable R&D agency, create renewable tax incentives, and shift national labs from defense R&D to more commercial renewable energy projects.
- Would prohibit drilling in Alaska's

Arctic National Wildlife Refuge.

- Would unilaterally cap U.S. CO₂ emissions at 1990 levels by 2000 and encourage others to do so. Promotes accelerated CFC cuts.

Clinton created a state Department of Energy to emphasize renewable resources and reduce barriers to conservation. Arkansas ranks 10th in state energy research spending.

Sen. Albert Gore's (D-TN) congressional work includes four amendments to the 1992 energy bill. One would accelerate government efforts to procure the most energy efficient products and provide energy efficiency grant money to states.

Gore also wrote *Earth in the Balance*. The book calls for a global Marshall Plan of dramatic environmental actions to avoid numerous worldwide disasters that he says will occur if we don't change course.

The Clinton campaign said its views on energy and environment were formed before bringing in Gore, but that some areas were "updated somewhat" based on Gore's views. Even though the book may not become policy, be sure to read it for a full view of the Gore half of that ticket.

—Mark T. Hoske, News Editor

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Peak demand...

such as pools, are also reported to be down in many regions.

Two major weather disturbances may have contributed to unusual 1992 weather.

In June 1991 the Philippines' Mt. Pinatubo erupted. The resulting air-borne debris is spreading throughout the upper atmosphere, reflecting more solar energy, and shifting some global weather patterns. "El Nino," an unrelated 2-10-year cycle of warm Pacific currents, also has had an effect, according to meteorologist Jim Duthie at

WeatherBank, based in Salt Lake City.

As a result, many Midwest utilities' second-quarter reports read like a fall evening weather report, telling of "mild temperatures," and "cool weather in our service area." All regions show a drop in electric output, except for Rocky Mountain, Pacific Southwest, and Southeast areas, according to EEI. Gains in three regions, EEI said, contributed to a low overall increase of just 0.2 percent in electric output.

The U.S. Department of Energy confirmed that demand is steady "mainly because of milder first-quarter temperatures."

EL&P staff contributed to this report.

What Year Did the Highest System Peak Occur?

Investor-Owned Utility	Peak Demand (MW), Date		% Change, '91-'92	1991	Date	Pre-1991
	Jan.-Aug. 1992					
All-Time Peaks in 1992						
Carolina Power & Light	9235	July 14	3.1	8960	July 23	
Duke Power	14763	July 14	0.6	14677	July 23	
Florida Progress Corp.	6982	Jan. 17	15.3	6056	Feb. 16	
FPL Group	14661	July 9	3.8	14123	Aug. 12	
Pinnacle West Capital Corp.	3771	Aug. 17	6.9	3532	Aug. 9	
San Diego Gas & Electric	3335	Aug. 17	6.7	3089	Oct. 10	
SCANA Corp.	3380	July 13	2.4	3300	July 23	
SOE Corp.	18413	Aug. 17	10.2	16709	Oct. 2	
Dominion Resources	12942	July 14	0.02	12939	July 23	
Allegheny Power System	6530	Jan. 16	4.7	6238	Dec. 19	
Central & South West	10627	Aug. 10	4.2	10203	Aug. 1	
TECO Energy	2989	July 9	5.7	2829	Aug. 12	
All-Time Peaks in 1991						
American Electric Power Corp.	20175	Aug. 10	-9.8	22360	July 22	
Baltimore Gas & Electric	5558	July 14	-6.0	5910	July 23	
Boston Edison	2543	Aug. 26	-4.1	2652	July 23	
Cincinnati Gas & Electric	4101	N.A.	-1.4	4161	July 22	
CMS Energy	5932	Aug. 10	-2.5	6084	Aug. 29	
Commonwealth Edison Co.	15994	Aug. 10	-9.8	17733	July 22	
Consolidated Edison	9905	Aug. 14	-7.9	10752	July 23	
Delmarva Power & Light	2398	July 14	-1.3	2430	July 23	
DPL	2559	Aug. 10	-6.3	2730	July 22	
General Public Utilities	8067	July 14	-2.5	8271	July 23	
IPALCO Enterprises	2505	Aug. 10	-3.0	2583	July 22	
Kansas City Power & Light	2624	Aug. 10	-4.6	2751	July 22	
Long Island Lighting Co.	3611	July 14	-7.5	3904	July 23	
New England Electric System	3660	July 21	-13.9	4250	July 19	
Northern States Power	6100*	July 12	-13.8	7080	July 16	
Ohio Edison	5247	Aug. 10	-4.8	5513	Aug. 29	
Potomac Electric Power	5546	July 14	-3.9	5789	July 23	
PSI Energy	4827	Aug. 10	-1.6	4907	July 22	
Wisconsin Energy	4640	Aug. 25	-3.3	4797	Aug. 27	
Pre-'91 All-Time Peaks						
Centerior Energy	3599	Aug. 10	-7.1	3874	Aug. 29	4067 Aug. 1988
Detroit Edison	8703	Aug. 10	-3.1	8980	Aug. 29	9133 Aug. 2, 1988
DQE	2308	July 14	-3.9	2402	July 23	2522 July, 1981
Entergy	11963	July 8	0.9	11852	July 12	12189 Aug. 29, 1990
Gulf States	5247	July 7	-0.4	5224	N.A.	5604 Aug. 22, 1980
Houston Industries	11649	July 30	0.4	11601	Aug. 21	12216 Sept. 1990
Idaho Power	2244	June 11	5.6	2125	July 3	2327 Feb. 1989
Illinois Power Co.	3358	July 13	-5.1	3537	July 22	3775 Aug. 16, 1988
KU Energy	2845	July 13	-1.2	2894	July 23	2919 Dec. 22, 1989
LG&E Energy	2107	July 13	-0.8	2125	July 22	2149 July 10, 1990
Midwest Resources*	1208	July 8	-11.0	1358	July 22	1390 Aug. 27, 1990
New York State Electric & Gas	2524	Jan. 16	2.1	2471	Jan. 22	2587 Dec. 21, 1989
Niagara Mohawk Power	6159	Jan. 16	1.9	6045	Dec. 17	6326 Dec. 21, 1989
NIPSCO Industries	2718	Aug. 10	0.8	2696	July 22	2739 Sept. 6, 1990
Oklahoma Gas & Electric	4550	Aug. 10	-3.0	4690	Aug. 7	4890 Aug. 29, 1984
PacificCorp	7042	June 23	-4.0	7338	Jan. 29	7735 Dec. 20, 1989
Pennsylvania Power & Light	5876	Jan. 16	4.4	5627	Dec. 19	5884 Dec. 22, 1989
Portland General Electric	2906	Jan. 7	7.3	3136	Jan. 4	3698 Dec. 20, 1990
Puget Sound Power & Light	3837	Jan. 7	-5.8	4073	Jan. 29	4615 Dec. 21, 1990
Southern Company	23970	July 9	-5.1	25261	July 23	25981 Aug. 29, 1990
Southwestern Public Service	3205	Aug. 10	2.8	3118	July 10	3217 June 26, 1990
Texas Utilities	17525	Aug. 10	3.4	16952	Aug. 8	18007 Aug. 30, 1990
Union Electric	7135	July 13	-3.1	7367	July 22	7485 July 9, 1990
Washington Water Power	1309	Jan. 22	-11.1	1472	Jan. 29	1680 Feb. 2, 1989
PacificCorp	18594	Aug. 11	-0.1	18620	July 2	19400 Aug. 9, 1990

*Only for Iowa Power. Combined numbers with IPS, unavailable. + Estimate

Source: EL&P 1992 Investor-Owned Utility Survey of Peak Demand

1st Phase 1 unit complies by buying scrubber services

GARY, IN—Northern Indiana Public Service Co. dedicated someone else's scrubber in late August. As a result, two 1960's vintage units at NIPSCO's Bailly station are the first Phase 1 units to comply with the Clean Air Act Amendments of 1990.

NIPSCO doesn't own the new, 8150-million emissions control equipment at Bailly, but buys sulfur-removal services, the first such U.S. arrangement for scrubber operation.

The scrubber started operating in June, 2.5 years ahead of the 1995 Phase 1 deadline, because it was partially funded by the U.S. Dept. of Energy through the second round of the Clean Coal Technology program.

Pure Air, a partnership of Mitsubishi Heavy Industries and Air Products and Chemicals, owns and operates Bailly's scrubber. NIPSCO agreed to pay Pure Air approximately \$20 million per year for 20 years—equivalent to about \$400 per ton of SO₂ removed at current operating levels and coal sulfur levels.

(The range of two publicly announced SO₂ allowance trades was \$250-400, EL&P, 6/92, p.1).

NIPSCO and Pure Air still have to negotiate how excess allowances will be treated; the contract was signed before CAAA was passed.

Robert Conley, president of Allentown, PA-based Pure Air, said in previous comments that "the value of the allowances is a big part of using flue-gas desulfurization systems."

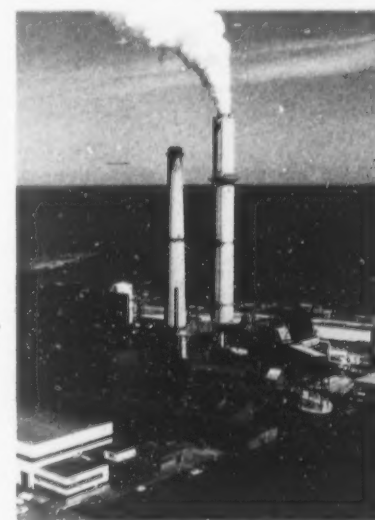
The scrubber on the two Bailly units, totalling 528 MW, reduces SO₂ emissions by 50,000 tons per year. The plant will comply at 85 percent SO₂ removal, said Conley, but the contract calls for 90-percent removal, so "it definitely will generate allowances," he said. The plant can run at removal rates of 95 percent or more.

Pure Air proposals to other utilities include partial payment in excess allowances as an option, Conley noted.

The Mitsubishi scrubber design is also the first in the U.S. to rely on a single absorber module. It has other innovative design features, including the production of high-purity calcium sulfate which is used for wallboard manufacture. U.S. Gypsum Co. has a 20-year contract with NIPSCO to buy a minimum of 140,000 tons per year of the synthetic gypsum.

It is also the largest scrubber for high-sulfur coal. Bailly uses local coal.

All 11 NIPSCO coal-fired units now comply with Phase 1, without an immediate rate increase, noted chairman and CEO Edmund Schroer. "A modest rate increase may occur in 1996, at the earliest...less than 5 percent," he said.



NIPSCO relies on sulfur-dioxide removal from the Pure Air scrubber at Bailly station.

Sales incentives attract greater interest from electric utilities

Thomas R. Mott-Sandra R. Miller
Hewitt Associates
Lincolnshire, IL

Competitive industries have long embraced sales incentive compensation as "fuel" for the personal selling engine that contributes so much to their success.

Company after company has adopted, modified, and enhanced innovative sales compensation and recognition techniques. What do these organizations have in common? Each uses financial rewards to communicate their priorities and influence sales force behaviors accordingly—and to drive time, effort, and initiative toward achievements that are important to their mission.

What about utilities? Until recently, there has not been much to report in the area of sales incentive compensation. Many gas utilities have well-developed sales incentive compensation programs for commercial, industrial, and residential salespersons. And, utilities selling appliances have typically adopted the prevalent commission models found in "big-ticket" retail selling.

The norm, though, is mostly salary, mostly security-oriented, and definitely outside the "motivation" arena. Sales compensation has not become a common term in the utility industry.

In the past, the customer service personality of utilities made sales incentives inappropriate. This is no different

than in competitive industry, where customer service personnel tend not to participate in incentives in a substantial way. The customer service world is not cash-incentive rich.

In contrast, the typical sales employee working for a major non-utility corporation will have incentive opportunities as well as a salary.

It is not unusual for salespeople to have 20 percent to 40 percent (or more) of their targeted cash compensation at

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Work continues on massive multi-state Andrew recovery

Hurricane Andrew may require the most extensive cleanup ever for U.S. electric utilities. Some service won't be restored for as long as 44 days, and utilities will be working for months making permanent repairs to temporary patches in the systems.

Andrew, a four on a five-scale level of severity hit Florida on Aug. 24 with sustained winds of 140 mph and gusts up to 165 mph, according to Accu-Weather Inc., based in State College, PA. Louisiana sustained an initial impact of 120-mph winds and gusts to 140 mph on Aug. 26, Accu-Weather said.

Florida officials estimated Andrew's damage could total \$20 billion just in that state. In comparison, Hurricane Hugo, in 1989, caused \$10 billion in total damages.

Florida Power & Light, the heaviest hit utility, had 1.4-million customers out at the peak, with damage concentrated in south of Miami.

Seventeen days after hurricane Andrew hit FPL, 84,000 customers were still without power; full restoration may take until Oct. 7 to all areas able to receive power.

The Homestead, FL, municipal utility was virtually wiped out, along with a majority of the buildings in the city of 20,000 residents, according to the American Public Power Association.

In Louisiana, about 322,000 customers lost electric service.

In related news, energy futures contracts jumped with speculation of oil and natural gas shortages from hurricane destruction to area production facilities. Industry sources reported limited damages with no long-term effect on price or availability.

No estimates were available on the cost damages to FPL facilities. On Sept. 9, FPL spokesperson Stacey Shaw said "so much area has not been completely surveyed, it's still premature to be asking."

Bob Marshall, FPL vice president for power distribution, said FPL used multiple decentralized command centers to put resources closer to the need. About 3500 office workers were previously trained as damage scouts to help repair crews. Supplies were stockpiled and prepackaged in sets. Experience from hurricanes Hugo and Gilbert helped, Marshall added.

Despite preparations, some scenes were surprising.

FPL's Bill Swank said, on Aug. 25, the day after Andrew hit, "Entire neighborhoods are gone with just concrete pads

Australian utility tests arcing fault detector

MELBOURNE, AUSTRALIA—An intelligent device for detecting arcing faults in power lines has been successfully tested by the State Electricity Commission of Victoria (Australia). The device, which was developed at the Royal Melbourne Institute of Technology (RMIT), proved capable of detecting arcing faults very accurately and selectively.

The leader of the RMIT research team, Majid Al-Dabbagh, said that if this device were to be installed on power line feeder stations, a great improvement would be achieved in detecting and isolating faults.

The device interrupts the circuit immediately upon detection of arcing. It uses a pattern recognition technique to detect faults.

Al-Dabbagh has been working on this research for five years in collaboration with SEC Victoria and assisted by a grant from the Australian Electrical Supply Industry Research Board. SEC Victoria has installed a prototype in a substation for further assessment.

remaining. You can't imagine the amount of damage. Huge concrete transmission structures were snapped off like sticks."

Swank added, "This was the worst hurricane to hit a major metropolitan area this century in terms of damage."

FPL had as many as 987 line and 418 tree crews at work, 746 of its own and the others from five nearby utilities. A total of 3300 utility workers helped, from Florida, Alabama, Georgia, and South Carolina. Thefts of downed lines and new supplies hampered efforts.

The destruction wasn't all to the power delivery system. Andrew came ashore near FPL's Turkey Point facilities. The two nuclear units were undamaged, but all connecting transmission was "ripped out." Two natural gas/oil units sustained "major structural damage" to the stacks, turbine deck, water tanks,

Clean air: acid rain rule due, regulators examine compliance

WASHINGTON—After missing deadlines for releasing Clean Air Act Amendment regulations, the Environmental Protection Agency made a new schedule. EPA expects to release a final rule on acid rain this month.

Utilities and state regulators continue work to meet compliance deadlines, which remain unchanged.

Some of the utilities hardest hit for SO₂ removal are Tennessee Valley Authority, Georgia Power, PSI Energy, and Ohio Power, according to Research Data International, based in Boulder, CO. Total SO₂ compliance cost for these four will be nearly \$1.2 billion, RDI said (see table).

The EPA boasts about 100 CAAA regulatory actions since President Bush signed the law in November 1991. EPA hopes to update its schedule and strategy annually.

Review in other administration departments has contributed to EPA's regulatory delays. EPA's Dave Ryan said NOx control regulations have been at the administration's Office of Management and Budget since April 15. An OMB spokesperson said on Sept. 10 that the NOx regulations were still under review and would not say when OMB would return them to EPA.

Delays affect utilities' ability to make compliance plans, and impairs state regulators' from establishing criteria to evaluate the plans.

A report released in mid-July by The National Regulatory Research Institute, Columbus, OH, says the most complex task state regulators face relates to making rules and procedures for compliance rate-making and SO₂ allowances (see flow chart).

The report explains portions of CAAA, the roles of state and federal regulators, and related policy issues. It's called "Public Utility Commission Implementation of the Clean Air Act's Allowance Trading Program."

and supporting buildings. A fuel oil tank was destroyed, but no oil leaked into the bay. The gas-fired Culter plant was also damaged. Full assessments were unavailable by Sept. 10.

Utilities send help

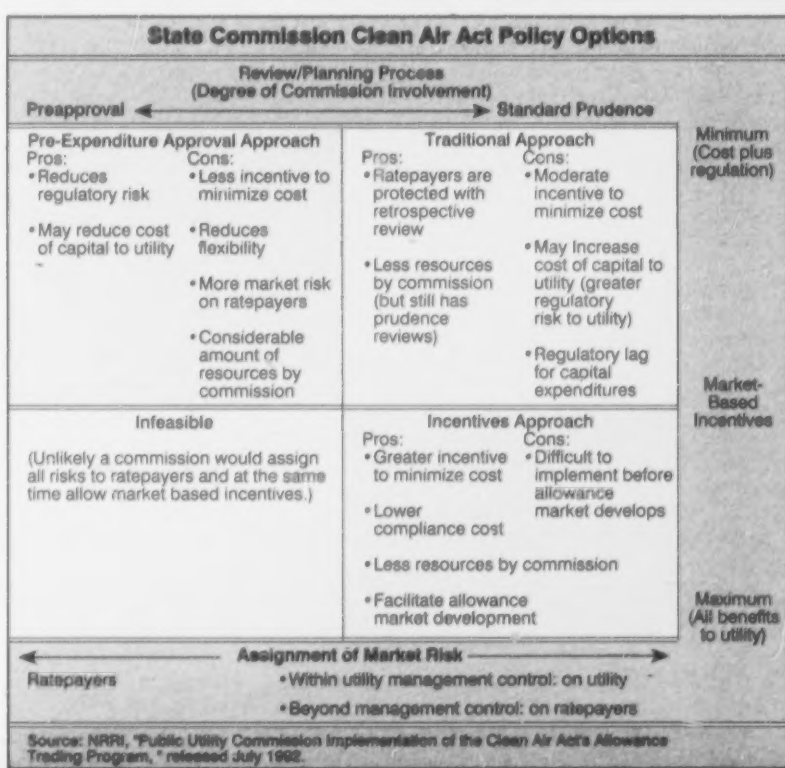
TECO Energy, adjacent to FP&L, sent equipment and 85 people to help the recovery effort. One spokesperson at TECO's Tampa Electric said, "There's intensive devastation down there. It looks like a bomb went off." South Carolina Electric & Gas sent 120 employees to help FP&L.

In Louisiana, Gulf States Utilities' Susan Gilly said that utility lost 160,000 customers at the peak; all were back the following week. No cost estimates were yet available for "extensive distribution and transmission line damage."

Morgan City, La. municipal utility estimated that cost for permanent repairs to its 6000-customer system could exceed \$2.5 million, according to Larry Bergeron, city administrator. Nearly all were restored by Sept. 9. The Morgan City plant, with 70 MW of natural gas turbines, sustained about \$800,000 in building and cooling tower damage.

South Louisiana Electric Cooperative Association lost all 15,500 customers in five parishes, according to Rickie Pitti, manager of member services. Help came from as far as Alabama and Texas. All residential service was restored by Sept. 5; some remote service remained out as of Sept. 9.

Central Louisiana Electric Co., Entergy's Louisiana Power & Light and New Orleans Public Service, and Teche Electric Cooperative, based in Jeanerette, La., also had damage.



20 Hard-Hit Utilities in Clean Air Act SO₂ Removal Based on Present Compliance Plan

Utility System	Phase 1				Phase 2			
	Total Cost Millions \$	Reduction 000s TSO ₂	Cost \$/TSO ₂	Cost ¢/kWh	Total Cost Millions \$	Reduction 000s TSO ₂	Cost \$/TSO ₂	Cost ¢/kWh
Tennessee Valley Authority	43	264	163	0.06	261	877	298	0.29
Georgia Power (SC)	76	135	563	0.11	250	686	374	0.31
PSI Energy Inc.	75	195	385	0.26	199	499	399	0.63
Ohio Power (AEP)	95	604	157	0.24	193	726	265	0.46
Pennsylvania Power & Light	30	97	309	0.09	137	390	351	0.42
Ohio Valley Electric Corp.	76	304	250	0.43	125	425	292	0.66
Union Electric	71	186	382	0.25	121	382	317	0.38
Alabama Power (SC)	22	28	786	0.06	112	146	757	0.25
Virginia Electric & Power	18	47	383	0.06	110	216	509	0.31
Duke Power	NA	NA	NA	NA	101	198	639	0.22
Ohio Edison	23	98	235	0.10	94	234	402	0.37
West Penn Power (APS)	40	112	357	0.19	85	233	365	0.36
Illinois Power	41	101	406	0.29	81	261	310	0.50
Potomac Electric Power	10	50	200	0.05	78	166	470	0.35
Cleveland Electric Illuminating	37	103	359	0.23	77	231	333	0.45
Appalachian Power (AEP)	25	†	†	0.07	73	153	477	0.19
Niagara Mohawk Power Corp.	11	23	478	0.12	73	102	716	0.76
Indianapolis Power & Light	20	50	400	0.14	70	80	675	0.43
New York State Electric & Gas	6	20	300	0.04	62	124	500	0.34
Tampa Electric	37	65	544	0.21	58	150	385	0.29

NA — Not affected in Phase 1 TSO₂ — Tons of SO₂
† — Accrued costs are related to the purchase of SO₂ allowances.

Source: "Bulk Power Markets in the U.S.," Resources Data International, Inc. March 1992.

Sales incentives...

In a "typical" non-utility competitive company we might find a salesperson in one territory in a particular year earning twice what his or her "neighbor" makes in the same company. Ideally, such earnings differences are justified by the revenue or other sales-oriented contributions of these sales employees, often related to quotas or other goals.

Reasons to Implement	Percent of Human Resource Responses	Percent of Sales/Marketing Responses	Percent of Total Responses
Support Strategy/Provide Direction	37 %	16%	25%
Increase Revenues/Profits	23%	26%	25%
Enhance Motivation	18%	29%	25%
Meet Competitive Pressures	14%	3%	8%
Top Management Desire	9%	0%	4%
Increase Sales Productivity	0%	19%	11%
Recognize Importance/Contribution of Sales	0%	6%	4%

Source: Hewitt Associates Survey

Electric utilities are discovering how incentives can help meet strategic goals in demand-side management.

It is significant that the electric utilities paying these small incentives have not modified the process or policies by which salaries are administered for the covered sales employees. So, unlike their non-utility counterparts, these utility salespeople would probably not perceive that a portion of their planned or "target" total cash compensation is contingent on meeting sales goals.

- Electric utility executives are becoming increasingly more affected, personally, by incentive pay practices. Surveys show a trend toward more, and larger executive incentives in electric utilities over recent years. The executive whose pay is contingent on results often seeks ways to stimulate the same kind of "eco-

HIGH-PERFORMANCE POWER INSTRUMENTATION

Internal data logs provide time and date stamped min, max, event alarm, and historical snapshot recording. Three setpoint-controlled, 10 Amp relays can be used for a variety of automated control operations. Four status inputs can be used for external equipment monitoring.

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from page 8

Sales incentives...

economic urgency" among those in the company who can really move the needle on the company's speedometer.

• All industries share frustration at the inability to recognize and reward superior performance through meaningful merit increases. Minuscule budgets have taken their toll on salary-based pay-for-performance efforts, and this has sent compensation professionals looking for avenues to implement other reward systems—wherever the possibility exists. We have heard the comment, "maybe we can at least get some kind of pay for performance going in the sales area, where results are more measurable."

Customer persuasion

Demand-side management (DSM) programs provide the kind of "customer persuasion" opportunities that have been in short supply for many electric utility salespersons.

Our counterparts in other industries might find it confusing, or at least amusing, to provide incentives to salespeople for influencing customers to use less product, or to use it more extensively when its price (rate) is lower. Nevertheless, the selling principles in DSM are much the same as in sales compensation programs that reward demand creation:

- Identify the potential sales opportunity with a particular customer and listen to the customer to define the perceived need.
- Build the logical case for your program to satisfy the need and present the case to the customer.
- Overcome customer objections and close the sale.
- Get the reward for your effort—but, be psychologically prepared for a "no thanks" (and no reward!).

The sales process described above, applied to DSM program selling, lends itself nicely to incentive compensation.

In the Indianapolis conference, both Wisconsin Electric Power Co. and Northern States Power Co. presented their experiences with programs that reward employees for DSM results achieved through sales effort. These were cash programs, funded by formulas and driven by goals. Team and individual components were present.

At the conference and in ensuing months we have noted that a number of other electric utilities have, or are developing programs of their own. Experimentation? It seems more than that.

Barriers remain

Will sales incentive compensation become the norm, rather than the exception, among electric utilities in the near future? The trend toward sales incentives may continue. Certain barriers remain, however.

- Two-thirds of the survey respondents at the Indianapolis conference said that "choosing performance measures" would represent a major challenge in implementing a sales incentive program.
- Nearly half of the Marketing/Sales people responding to the survey said that clarifying job roles and accountabilities would be a necessary and challenging step before introducing incentives.
- Nearly half of the Human Resources respondents said they felt that the systems to track results in the utility sales environment would be problematic.
- About 50 percent of attendees expressed reservations about "program design." Perhaps they have trouble visualizing a sales incentive program at their utility; and, maybe they have never tackled an incentive design project.

Electric utilities will probably become more comfortable with incentive compensation for salespeople as the num-

ber of programs increases in the industry. For now, most lessons in sales incentives may need to be borrowed from other industries where similar issues exist—such as telecommunications (with its regulatory heritage), banks (with cultures that have been more security oriented), and any industry where the sales process involves extensive technical support.

Open-ended question

An open-ended question at the close of the survey, for those utilities without sales incentive programs, asked: "What do you believe is the most compelling reason to implement cash sales incentives at your utility?" We summarized 53 narrative responses as shown in the table.

The answer patterns were a bit differ-

ent between the human resources and the marketing/sales respondents.

Three themes emerged, in equal strength, as the primary reasons to initiate cash sales incentives at a utility:

- To support the strategic direction of the enterprise and provide an appropriate focus for sales and marketing efforts.
- To contribute to desired increases in revenue and profits.
- To enhance motivation of sales personnel.

When and if utilities embrace the concept of sales incentive compensation more fully, this data suggests they will do so for the same reasons as companies in other industries where competition has been the accepted order.

When an organization decides sales incentive compensation might be time-

ly—then what? The wrong approach is to jump in and "try something" with the notion that it can be fine tuned later based on experience. Just as a well-designed program gets results, a poorly-designed sales incentive compensation plan can have devastating effects on employee morale and employees will not soon forget the bad experience.

Electric utilities that look carefully at feasibility first before "leaping," and those that follow a thoughtful installation process, can benefit from the sales compensation experiences in the many industries that have blazed the sales compensation trail ahead of them.

David Marder, president of Hewitt Associates' Utilities Consulting Group, McLean, VA, also contributed to this story.

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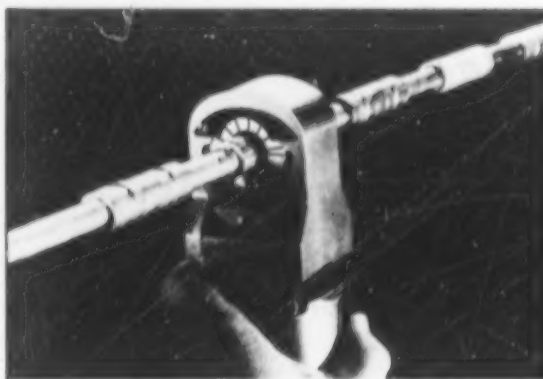
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Inquire R.S. 6

Forced outages are worst in first week after planned outages

PRINCETON, NJ—Generating units have forced outages more frequently during the first week of service of a large coal-fired unit after a "long" scheduled outage than any other time, according to a new report from the North American Electric Reliability Council.

NERC studied records of baseload coal-fired units with capacities of 440 MW or greater to reach this conclusion, which covered the period 1982-1988. The report is called "Generating Unit Availability Following Planned Outages."

Specifically, the study showed:

- There is a 47-percent chance such a unit will have its first forced outage on the day it returns to service after a

planned outage of a week or more.

- If the unit does not see the first-day outage, there is a 5-percent chance it will have a forced outage on the second day.

- There is a 63-percent chance of having a forced outage in this first week.

- About 11.6-percent of all forced outages for such units will occur during this first week (see figure).

- Forced Outage Factor will decline significantly with each successive day during the first week after such a planned long outage. (Forced Outage Factor is the ratio of forced outage hours to total hours in a time period.)

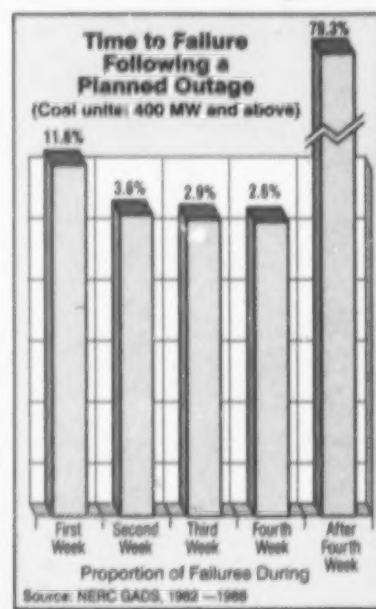
- About 60 percent of these forced outages that occur during this first week

will last less than a day.

The study reports that the two major contributors to forced outage hours during the first week were boiler tube leaks and turbine vibration. The next-most significant contributors were boiler control systems and turbine over-speed-trip test failures.

Yet a turbine problem was the most likely cause when an outage took place on the first day (40 percent of the failures). Boiler problems accounted for the next-highest number of first-day failures (31 percent).

After the first week, the failure frequencies essentially reversed. Boiler-related problems were the most significant cause of forced outages in the en-



the interval between planned outages (53.6 percent), while turbine-related causes were next (16.6 percent).

The study was conducted by the Forced Outages Following Scheduled Outages Task Force of NERC's Generating Availability Trend Evaluation Working Group (GATE). Principal data used by GATE was NERC's own Generating Unit Availability Data System (GADS).

The GADS database used for the report covered seven years, 1982-1988, of outage data. The database contained information on 21,406 outages—1,788 planned and 19,618 forced.

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Dangerous waste...

for recycling the metals.

They reported at the annual meeting of the American Chemical Society, that they take the hard material that makes up the primary component of the outside of the shellfish, called *chitin*, and make tiny, magnetized *chitosan* beads. The porous beads specifically soak up heavy metals from contaminated water.

The *chitosan* biopolymer is stable and has 100 times more pore volume than flaked *chitosan*, the form it normally is used in for other purposes.

The beads adsorb the metals when just mixed with contaminated water. They then can be easily retrieved with a magnet. They also can later be treated to give up the heavy metals.

Way said, "They're [the beads] mostly empty space. One gram of this material has about 150 square meters of surface area."

The researchers have used the beads on cadmium in the laboratory, and feel the beads will work on other heavy metals, as well. Rorrer and Way plan field tests in about two years.

Meanwhile, they are exploring other uses for the beads and attempting to optimize the waste adsorption characteristics.

Rorrer noted, "The *chitosan* beads should be cheap and easy to produce. They're environmentally benign, natural, and biodegradable." He also declared, "And they appear to adsorb some heavy metals as well as the best commercial processes now being used."

Way added, "By making our compound magnetic and using special types of fluidized-bed technology, we should be able to manipulate and release the captured heavy metals from the *chitosan*." That way, the beads could be reused repeatedly and also could create a concentrated heavy metal stream to recover some of the valuable materials.

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Inquire R.S. 9

Next generation nuclear plants—innovative, but facing opposition

Henry Stein
Senior Editor-Power Production

With promising advances in new initiatives, hopes are high for an upcoming resurgence in interest and acceptance of nuclear-powered electrical generation in the United States. It never faded in countries such as France, where more than 72 percent of the nation's 1991 electric power was nuclear-generated. And Japan is leading the way in building both new nuclear plants and new types of nuclear plants.

But a number of strong obstacles still stand in the way before a resurgence can begin in the U.S. Various groups have plans to overcome these obstacles.

Standardization, safety

"The commission has long sought nuclear power plant standardization, and the enhanced safety and more predictable licensing regime which standardization could make possible,"—Ivan Selin, chairman, U.S. Nuclear Regulatory Commission, addressing the American Nuclear Energy Council at its 18th Annual Nuclear Power Assembly, May 1992.

By standardizing plant designs and construction, the Nuclear Regulatory Commission (NRC) and nuclear industry hope to keep costs down to the point where nuclear units are economically competitive with other popular types of generating power.

"The NRC expects that the next generation of nuclear power plants will be significantly safer than the already existing... designs. The new designs will be simpler, more tolerant of human error, more easily maintained, and less dependent upon active human or mechanical intervention to maintain normal operation,"—NRC Commissioner Forrest J. Remick at the dedication of the Penn State University Breazeale Reactor, May 1992.

No emissions

"Nuclear plants produce no airborne emissions, no sulfur oxides, no nitrogen oxides, no particulate matter, and no greenhouse gases,"—Sherwood H. Smith Jr., chairman, president and CEO of Carolina Power & Light Co., and chairman of the Nuclear Power Oversight Committee, writing in the Forum for Applied Research & Public Policy, winter 1991.

Costs

The U.S. Council for Energy Awareness (USCEA) stated in July that the cost of building and running a 600-MW reactor over 30 years would add up to 4.5/kWh (in 1990 dollars). USCEA also said that the cost for the larger 1200-MW plants would be about 4.3/kWh. These estimates, if they prove out, would place nuclear power plants as direct economic competitors with pulverized-coal and gas-fired power plants. Subsequently, some of the vendors estimated even lower costs from their new designs.

Among the assumptions used in the USCEA analysis were: approval of the revised licensing process by Congress; certification of standardized plant designs under 10 CFR Part 52; and improved performance leading to capacity factors in the 80-percent range. (Currently, nuclear capacity factors are in the 70-percent range.)

Delays

However, in late June, Chairman Selin said although standardization and licensing reform were making progress, the stalemate in developing a high-level waste-disposal site was the largest impediment to building the new reactors. Congress gave the Department of Energy (DOE) the go-ahead to perform scientific studies of areas for a permanent high-level waste storage facility in 1987. But state officials and environmentalists opposed the Yucca Mountain, NV, site chosen and have delayed the studies.

The new, simpler licensing procedures of 10 CFR Part 45 announced by the NRC in April of '89 will have to be approved, too, in order for utilities to become interested in building nuclear power plants. The revised procedures would allow the NRC to preapprove both the proposed sites and the standardized plant designs, greatly shortening the design/

Focus On New Nuclear Technology

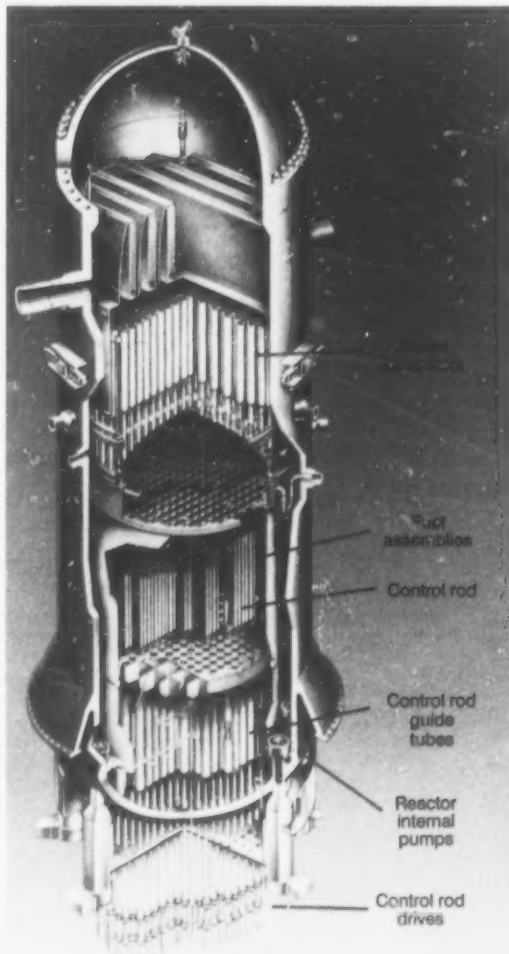


Figure 1 GE's ABWR is first in line for NRC certification, but the process has hit delays

build time period.

A builder could match site and design, and have them approved prior to applying for a combined construction permit/operating license. After a public hearing, the NRC could issue the combined license. These steps would substantially reduce construction time and capital costs.

However, the new procedures must be passed by Congress and upheld by the courts before they can become effective.

Another governmental problem involves rate setting. An investor-owned utility planning a nuclear plant would need assurances from the state regulatory commission that the rates set would be sufficient to offset the financial risks of a nuclear plant's construction. According to Smith, since 1984, more than \$15 billion in such costs have been disallowed.

Taking big chances

The Nuclear Power Oversight Committee (NPOC) published "A Strategic Plan for Building New Nuclear Power Plants." This nuclear industry group's plan committed the industry to specific tasks for achieving that first plant order in '95.

In its late-'91 update for the plan, however, NPOC noted the delay thrown in by "inability to secure final agreement with the U.S. Nuclear Regulatory Commission on design-related issues."

An association of utilities, the Advanced Reactor Corp. (ARC), signed an agreement with DOE on Feb. 18, 1992, to cooperate in jointly funding advanced light-water reactors (ALWRs). DOE-ARC's aim is to complete designs to the point of commercial standardization. Hopefully, this will result in new plant order by 1995, one of the objectives of President Bush's National Energy Strategy. Cost is to be \$200 million over five years, shared equally by DOE and ARC.

Matching funds

The nuclear industry's \$100 million in matching funds is to come half from utilities and half from its vendors. NPOC announced a firm commitment for its \$50-million share on Nov. 11, 1991, and said it had almost 90 percent of the money already pledged. By early August, all the utility and vendor money had been pledged. And on Aug. 14, ARC issued a formal request for proposals to three manufacturers developing the next-generation reactor designs—ABB Combustion Engineering, General Electric Nuclear Energy, and Westinghouse Electric Corp.

The main goals of the program are:

- Complete engineering designs for the ALWRs in sufficient detail to define firm cost estimates, prepare for construction, and support commercial standardization.
- Ensure that an institutional infrastructure is in place to provide resources and manage completion of detailed designs.
- Define the process for achieving commercial standardization.

Contrary views

Yet a committee formed by Congressional request at the National Research Council evaluated seven designs that had been proposed for the "next-genera-

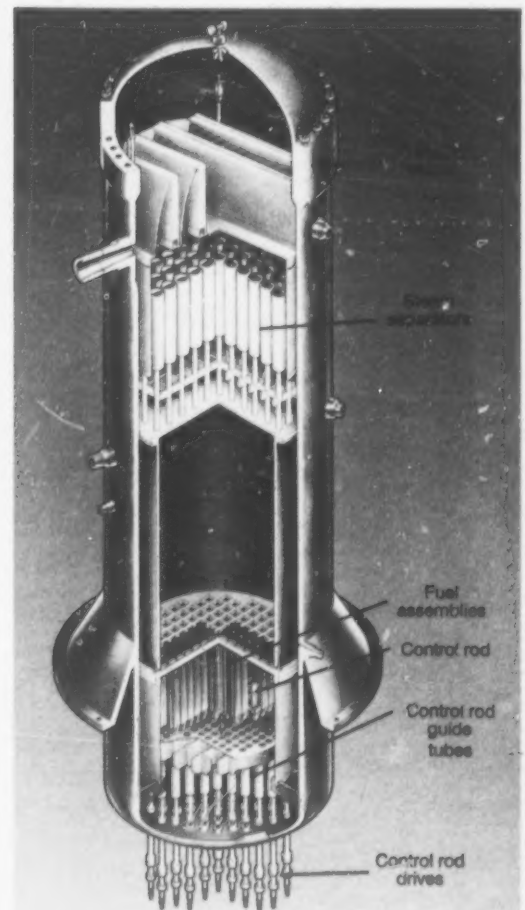


Figure 2 GE's SBWR is very similar to the ABWR, but the SBWR features passive safety systems

tion" reactors and did not recommend quite the same agenda as the government and industry were following.

In June the committee said the large, evolutionary, light-water reactors should get no federal funding, except for some "incentives" that possibly might help speed their deployment.

It did recommend federal funding for two of the designs—the mid-sized, light-water reactor with passive safety features and a liquid-metal reactor. The committee also recommended dropping or not considering any spending of government money for the Modular High-Temperature Gas-Cooled Reactor, safe integral reactor, Canadian CANDU-3, and Swedish pressurized light-water reactor.

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Next generation...

The council committee also felt the large, evolutionary LWRs would be the least costly to build and operate; the mid-sized LWRs with passive safety, the next most expensive; and the high-temperature gas-cooled and liquid-metal reactors, the most expensive.

An even stronger stand was taken by the Union of Concerned Scientists, a Washington-based advocacy group. The Union's July 17 report strongly disputes the safety claims for the new-generation reactors. The report even says the vendors and federal government lack the technical information necessary to make confident and accurate predictions about safety and risk characteristics of the new designs.

To narrow the job down, however, the report concentrates on three designs—the AP600, Modular High-Temperature Gas-Cooled Reactor (MHTGR), and Power Reactor Inherently Safe Module (PRISM). However, the AP600 is one of the advanced reactors scheduled for later certification, and the MHTGR and PRISM are still in early stages of design.

The report attacks the new site permit, certification, and licensing process promulgated by the NRC in 1989, presenting many reasons why the Union feels the process falls short. The main objection is to the combined licensing process and the way it "severely limits" public participation.

The Union also strongly objects to the terms and concepts of "inherent safety" and "passive" system, and whether they will work.

Design classes

The four U.S. nuclear power-producing designs being actively pursued that are nearing NRC certification are all ALWRs but can be divided into two classes. The first includes the large, evolutionary reactors exemplified by the GE Advanced Boiling Water Reactor

Comparison of Next-Generation Reactors

Reactor Name	Size (MWe)	Type	Fuel	Moderator	Control Rods	Load-Following Range	Construction Cost (\$/kW)	Production Cost (¢/kWh)	Status	Developer
Advanced Boiling Water Reactor	1350	Boiling Water	Enriched UO ₂	Deionized Water	B ₄ C	50-100%	\$1,400	1.3¢	NRC certification planned for Dec. 1992	GE Nuclear Energy
Simplified Boiling Water Reactor	800	Boiling Water	Enriched UO ₂	Deionized Water	B ₄ C	50-100%	\$1,700	1.5¢	NRC certification expected late 1994	GE Nuclear Energy
System 80+	1300	Pressurized Water	Enriched UO ₂	Deionized Water	B ₄ C and Inconel 625	50-100%	\$1,350	3.8¢	NRC design approval due Nov. 1993 Certification due May 1995	ABB-Combustion Engineering
AP-600	600	Pressurized Water	Enriched UO ₂	Deionized Water	Ag-In-Cd	50-100%	\$1,700	3.9-4.2¢	NRC certification due mid-1996	Westinghouse Electric
CANDU-3	450	Pressurized Water	Natural UO ₂	Heavy Water	Cd-Stainless Steel	60-100%	\$2,000	2.5-4.0¢	Expect 1st unit ready for service 1999	AECL Technologies
BN	1400	Pressurized Water	Enriched UO ₂	Deionized Water	B ₄ C	30-100%			Commissioning 1st unit expected 1995	Electricité de France

*Confidential per EDF

interrupted.

The evolutionary reactors, compared to their predecessors, are designed with greater safety margins, and for simpler construction, improved maintainability, lower operating costs, and easier operation.

The other reactors discussed here fall into completely separate classes. The CANDU is a reactor that uses heavy water (deuterium oxide) as coolant and moderator. The modular high-temperature gas-cooled reactor uses a gas to cool the core and graphite as the moderator. The liquid-metal reactor uses liquid sodium as the coolant and is a fast-neutron reactor.

ABWR

GE Nuclear Energy's 1350-MWe Advanced Boiling Water Reactor is the first ALWR being deployed commercially and first in line for NRC certification (see Fig. 1).

The ABWR was to be given design approval by the end of this year. But NRC staffers were still raising questions as of this writing. Consequently, there are doubts that they would finish work on a final safety evaluation report by August. So the NRC may not have enough time to decide on approval of the design by the early December time originally set. Questions were raised about the ABWR's control and instrumentation, piping supports, and radiation protection.

Since this is the first of the next-generation nuclear reactors to be considered for NRC certification, delays in its approval will probably cause backups that will hold up certification of

the other three designs.

Not waiting for the U.S., Tokyo Electric Power Co. (TEPCO) started construction for the first unit of the first-ever ABWR at Kashiwazaki-Kariwa station 140 miles northeast of Tokyo in Sept. 1991. The 1350-MWe unit is scheduled to go into commercial op-

eration in 1996. TEPCO's Unit 2, also 1350 MWe, began construction in Feb. 1992, with commercial operation slated for 1997.

GE is to supply the nuclear steam supply systems, fuel, and turbine generators. Other systems will be provided by Japan's Hitachi Ltd. and Toshiba Corp. The Japanese project is serving as a proving ground for advanced-design, light-water technology.

Key features of the ABWR are: passive severe-accident mitigation capabilities; recirculation pumps internal to the reactor; fine-motion control-rod drives; digital controls and instrumentation with multiplexed fiber-optic cabling; modular construction; inerted pressure-suppression con-

tainment with horizontal vents; and an advanced turbine-generator.

The ABWR and its companion SBWR share a common technology base. The common base includes basic BWR design, state-of-the-art electronics, computer technology, turbine design, and fuel technology. The essential differences are in power rating, core flow recirculation, and the extent to which safety systems rely on active or passive features.

Both the ABWR and SBWR use simplified designs for reactor core flow recirculation. The ABWR has 10 internal pumps for recirculation flow, while the SBWR utilizes natural recirculation that depends on liquid flow that is gravity-induced and temperature-induced.

The ABWR reactor core consists of 872 fuel bundles operating at a power density of 50 kW/liter (kW/l). Fuel rods have a zirconium barrier liner, axial variation of enrichment and gadolinia, no shallow control rods, and no rod pattern exchanges.

Eliminating external recirculation pump piping and using vessel forged rings does away with 50 percent of the welds in the primary system pressure boundary.

The fine-motion control rod drive is designed to reduce periodic maintenance, which also reduces associated occupational exposure. The control blades are moved electrically during normal operation. This feature allows for small power changes and shorter startup times.

Three systems provide for emergency core cooling and residual heat removal. Each of two of the systems provides high-pressure and low-pressure emergency core coolant injection. The third combines a reactor-steam-driven turbine pump for high-pressure coolant injection and a low-pressure coolant-injection system.

Control and instrumentation uses multiplexed signals along fiber-optic networks that work with a

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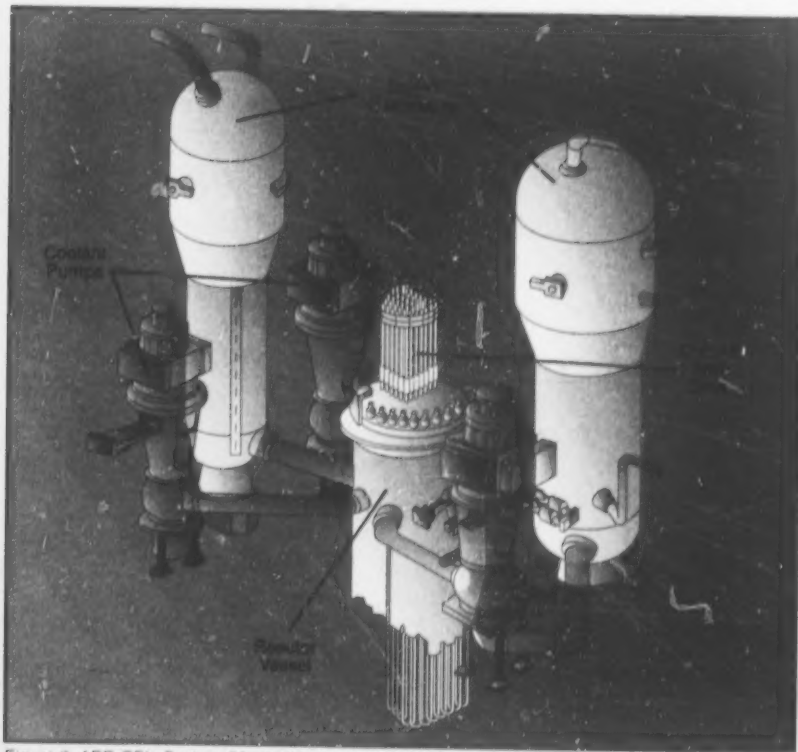


Figure 3. ABB-CE's System 80+ is the next of the large reactors in line for NRC certification.

(ABWR) and the Asea Brown Boveri-Combustion Engineering System 80+. These two are 1300-MWe-range units that still use active emergency systems.

The second class includes the more revolutionary, mid-sized reactors exemplified by the GE Simplified Boiling Water Reactor (SBWR) and Westinghouse AP-600. These two are 600-MWe units that use passive safety systems.

All four ALWRs rely more on automatic safety systems, rather than operators, to maintain safe operation if the cooling water flow to the core is

the other three designs.

Not waiting for the U.S., Tokyo Electric Power Co. (TEPCO) started construction for the first unit of the first-ever ABWR at Kashiwazaki-Kariwa station 140 miles northeast of Tokyo in Sept. 1991. The 1350-MWe unit is scheduled to go into commercial op-

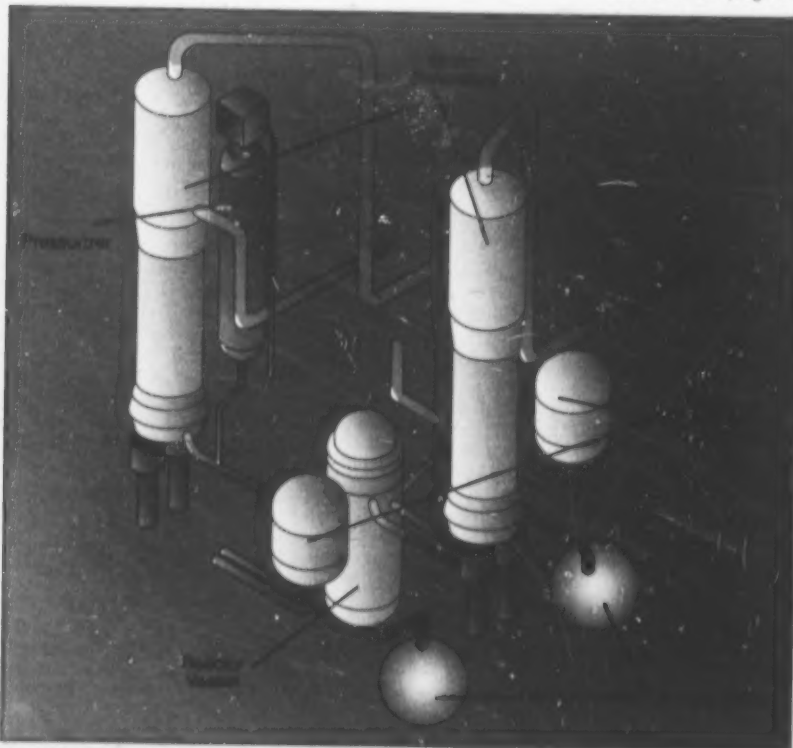


Figure 4. Westinghouse's AP600 may be the second of the new reactors to be NRC-certified.

From page 20

Next generation...

digital, solid-state control system. The resulting system increases system redundancy, provides fault-tolerant operation, and performs self-diagnostics while the reactor is operating.

The reactor building is steel-lined reinforced concrete. The reinforced-concrete containment vessel is the pressure-suppression type with a covered suppression pool.

SBWR

GE's 600-MWe Simplified Boiling Water Reactor is a smaller-sized advanced BWR featuring passive safety (see Fig. 2). GE Nuclear began design studies for it in 1982, and received a DOE contract for its continuing work in Sept. 1989. NRC certification is scheduled for late 1994.

The SBWR uses natural coolant circulation, gravity, and stored energy for "passive" safety. In case of an accident, the unit's safety system does not need pumps, traditional heat exchangers, or operator actions to cool the core down.

Its low power density (42 kW/l) gives the SBWR high thermal safety margins. At full power, the reactor operates with natural water circulation, so no recirculation pumps are needed. This results in a simpler reactor vessel, reduced vulnerability to coolant loss, and reduced maintenance. However, the reactor vessel must be larger to accommodate these features.

The suppression pool is above the reactor core. Thus, in an emergency, gravity-induced flow handles core cooldown, rather than injection pumps. Not only are the injection pumps eliminated, but so are the associated valves, piping, and diesel generator power supplies.

During normal operation, an isolation condenser passively controls reactor pressure. The condenser is located in a pool of water above the core and outside the containment. In the event of loss of coolant, the isolation condenser also can remove long-term, postaccident decay heat from the containment.

As with the ABWR, the SBWR uses a multiplexing system with fiber-optic data transmission, and microprocessor-based controls and instruments. And again, the equipment allows for fault-tolerant operation, fault detection, and self-diagnostics while the unit is operating.

Modular construction techniques are designed to reduce costs and shorten construction to about 30 months. Modularization is planned for reinforcing bar assemblies, structural steel assemblies, steel liners for containment and associated water pools, and some equipment assemblies.

System 80+

ABB-Combustion Engineering had submitted its application for standard design certification of its System 80+ to the NRC as of June (see Fig. 3). Plans called for the 1300-MWe pressurized-water reactor design to be approved by the NRC in Nov. 1993, and NRC certification was expected in 1995.

The design evolved from Combustion Engineering's System 80 nuclear steam supply system and Duke Power's P-81 design. Three of the forerunner System 80 units are operating at Palo Verde nuclear plant, and two are scheduled to be constructed in the Republic of Korea.

The System 80+ core design uses only control rods for reactivity control, which eliminates the need for adjusting boron concentration in the coolant. This simplifies reactivity control during load changes.

Reduced normal System 80+ operating hot-leg temperatures and revised monitoring methods increases core thermal operating margin compared to the

System 80. System 80+ steam generators have larger heat transfer areas and reduced full-power steam pressure because of lowered coolant temperatures. The larger heat transfer areas allow for the nuclear steam supply system to maintain rated output even though a number of tubes may be plugged.

The System 80+ has four trains (sources) for emergency feedwater injection. They are used for both low- and high-pressure injection of borated water into the reactor coolant. This design eliminates need for a dedicated low-pressure injection system and its cross-connects with the shutdown cooling system. An in-containment refueling water storage tank eliminates reliance on automatic or manual switchover of suction in case of a break in the primary coolant piping.

Controls and instruments utilize digital processing, fiber-optic data communications, and touch-sensitive video displays. Alarms are prioritized by the system. Control room computers reduce the amount of information presented continuously to the operator, yet allow access to all plant data when desired. Microprocessors continuously analyze and validate information to determine the most accurate readings.

The containment structure is a free-standing steel sphere enclosed in a cylindrical concrete shield building. This dual containment structure is designed to withstand severe core damage accidents that are worse than occurred at the Three Mile Island Unit 2.

Many systems and structures are modularized, so construction schedules should be 48 months, and then an addi-

tional six months would be needed for startup testing.

AP600

The Westinghouse Electric Corp. AP600 passive PWR final design certification was set for Nov. 1994. Westinghouse Electric Corp. expected to submit its 600-MWe design to NRC before the end of this year (see Fig. 4).

In the meantime, on March 16, the company and NRC signed an agreement for an experimental test program to support design certification for the reactor. The two organizations will share test data from three programs, two in the U.S. and one in Italy.

One of the U.S. tests will be at Oregon State University this fall. Low-pressure integral systems tests will be performed

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AMERICAN BEAUTIES



American Beauties for 1992. Nine outstanding plants with Westinghouse reactors. Prairie Island, Callaway, V.C. Summer, and Diablo Canyon — the only four plants commended by the NRC for their high level of safety. Prairie Island, North Anna, Point Beach, Byron, Callaway, D.C. Cook and McGuire — seven of the top ten most economical nuclear plants in the U.S. The operators of those plants have earned our admiration.



You can be sure... If it's Westinghouse

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Next generation...

on a one-quarter-scale AP600.

The other, passive-containment cooling-system tests, are being run at the Westinghouse Science & Technology Center near Pittsburgh.

The tests in Italy will be conducted by the state utility ENEL, the Italian regulatory authority ENEA, and the company SOPREN/Ansaldo in 1993. The program will provide baseline data on system interactions at high pressure.

The AP600 uses the proven uranium-oxide-fueled core, but with reduced coolant temperatures, flow rates, and core power density to increase thermal safety margins.

Mounting reactor coolant pumps in the channel head at the bottom of the steam generator simplifies their support system, reduces piping, and increases space available for maintenance.

Passive emergency core cooling is achieved with a combination of gravity drain of water from two core makeup tanks and a refueling water storage tank positioned above the level of the core. Also, two pressurized accumulator tanks can inject water into the core, if necessary.

Core decay heat also can be removed with a natural-circulation heat exchanger in the refueling water storage tank.

Controls and instruments use microprocessor-based technology, multiplexed controls for plant data and signals, electrical data links, and fiber-

optic data highways.

Modular construction allows for factory fabrication and assembly in 3-4 years after a construction permit is issued. The simplified modular design should allow for relatively short construction times and low capital costs that could compensate for any lost economies-of-scale.

CANDU-3

The AECL Technologies 450-MWe CANDU-3 (CANadian Deuterium Uranium) is a heavy water-cooled and -moderated reactor to be used in Canada and abroad for power generation. It is a pressurized-water reactor with its fuel in "channels" inside pressure tubes through which flow circulating heavy water coolant.

The pressure tubes are held inside near-atmospheric-pressure "calandria" tubes. The calandria tubes penetrate and pass through the calandria tank containing the heavy water (deuterium) moderator. A shield tank surrounds the calandria tank.

AECL sent a letter of intent to submit the design for certification under 10 CFR Part 52 in 1989. The company is continuing to submit preapplication material to NRC that will lead to a formal application for design certification.

This reactor is the latest and smallest version of the CANDU series. It is highly standardized, as are all in the series. All key CANDU-3 components—steam generators, coolant pumps, pressure tubes, and refueling machines—are identical to those in all other CANDU power plants. However, besides being smaller than the others, the CANDU-3 is highly modularized.

Other CANDU-3 features are: natural uranium oxide fuel; heavy water as moderator and coolant; and online refueling.

Two separate, independent shutdown systems can automatically stop the reaction. The primary system is a set of 24 spring-assisted rods that drop into the reactor by gravity action. The second system injects a neutron-absorbing poison, gadolinium nitrate, into the low-pressure moderator. Gas-filled tanks force the fluid into the moderator.

The emergency core cooling system provides for both short-term injection from pressurized accumulator tanks and long-term recirculation of a mix of normal and heavy water. The reactor has a positive void coefficient during a large loss-of-coolant accident that can produce a power rise of 50-100 percent per second. This rise must be counteracted by one of the two independent shutdown systems.

CANDU reactors use digital computers for control of the reactor regulating systems and other process systems (such as pressurizer and steam boiler level). However, the CANDU-3 introduced a distributed control system to replace the two large central computers used on its forerunners. The distributed system is linked by coaxial cable data highways.

Modular construction can be used for the CANDU-3. Contents of each station building are subdivided into modules on a system and subsystem basis. Modules and standard interfaces between them facilitate site assembly and minimize construction time. For instance, fuel channels and steel calandria can be factory assembled.

A reinforced-concrete containment building surrounds the reactor and steam generator units.

N4

The Electricité de France 1400-MWe N4 reactor uses 205 fuel elements, four steam loops, and five groupings of control rods. It is designed to load-follow at up to 5 percent of maximum power per minute.

The Arabelle impulse turbine was specially developed by Alsthom for this reactor. Although turning out an increase of 100 MWe over the previous model turbine, the Arabelle is 10-percent shorter, weighs 15-percent less, and is 1.5-percent more efficient.

The new alloy for steam generator tubes is Inconel 690, which is designed to improve corrosion resistance and reduce exposure of operators to radiation during maintenance due to its low nickel and cobalt release rate.

The control room features wide-scale integration of control and data displays. In all circumstances except emergency situations, control is performed solely with these computerized control and data display facilities. Conventional equipment is limited to emergency controls and some information about main control parameters.

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ELECTRIC LIGHT AND POWER • OCTOBER 1992

Dielectric tester saves \$4400 per yr

ROCK ISLAND, IL—A computerized oil-testing system has enabled Iowa-Illinois Gas and Electric Co. to test 800 samples of oil annually at a savings of \$4400.

The system has a rotating turntable capable of holding 24 sample containers. A probe assembly on a linear actuator tests each sample until breakdown. The dielectric strength is read and printed by a PC equipped with a single-channel analog data-acquisition board and a 16-channel digital-control board—both manufactured by Real Time Devices, State College, PA.

The dielectric strength is read by measuring a millivolt metering signal from a Hipotronics power supply.

The software for the program is written in GWBASIC and permits the operator to enter the number of samples to be tested and the number of tests to be performed on each sample.

A two-part label is used to report the test results. The labels are printed by a PC containing maintenance records of all oil-filled equipment. The labels are sent to the field to be placed on the sample jar before the sample is taken from the device. After testing, a label is placed adjacent to the test record.

The automated system has produced substantial cost savings over the previous manual-testing system and has standardized test procedures that yield more consistent test results.

SCADA/EMS spending rebounds

ROSEVILLE, CA—Electric utilities plan to spend more than \$667.7 million on supervisory control and data acquisition systems (SCADA) and energy management systems (EMS) during the 30-month period from July 1992-January 1995, according to CSR Inc.'s survey of 1462 utilities. In addition, another \$137.6 million will be spent on peripherals and consulting.

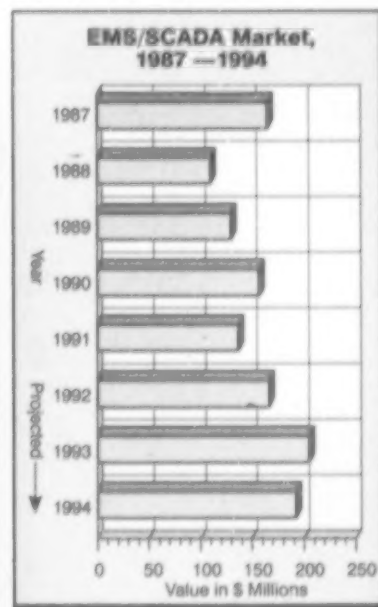
Type of Project	# of Projects	\$(10 ³)
Systems	385	667.674
RTU Add-On	243	64.720
Consulting	95	4.755
Mapboard	103	7.057
Communications	196	61.115

The SCADA/EMS market was \$165 million in 1987 and dropped the following year to \$110 (see Figure). The market rebounded strongly in the next two years but fell in 1991 to \$137 million.

The 3-year projections for 1992-94 show a strong market. CSR's method of tracking shows that, in the 12-month period following the annual study, between 58 and 62 percent of the systems market plans will actually be awarded. The rest will be delayed or, in some cases, cancelled.

CSR says that national and international economies can cause an unpredictable recession or expansion. The recent recession has had a depressing effect on the 1991 and 1992 contract awards. CSR expects the 1993 awards will be back on the normal track.

The study lists the total dollar amounts by company and the number of projects by company.



Plant research may help clear rights-of-way

HAGERSTOWN, MD—Allegheny Power System and the International Society of Arboriculture Research Trust will seek ways to control the rising costs of right-of-way maintenance in a five-year research project.

APS spent \$32 million last year on such maintenance.

Michael Watson, Potomac Edison Co.'s supervisor of forestry, helped develop the agreement which covers nine projects, including wood chip disposal; genetic engineering of plants; and ecological succession and allelopathic relationships of plant communities. (Some plants control competitors' growth with toxin releases.)

Other projects are a herbicide injection system; mechanical clearing equipment; cultivated street trees; debris vacuum; slide library of low-growing trees; and lightweight, portable tree climbing systems.

Priority list

"We hope that our involvement will stimulate utilities, manufacturers and others to get involved to increase the scope of the research," says Watson.

"Vegetation control research is not high on the utility industry's R&D priority list, which is surprising considering how much money is spent and the impact on customer relations," he adds.

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Prudent avoidance works best for Denver in EMF case

Lawrence E. Powell
Edwin J. Johnson

The judge at Denver's City and County Building discovered significant, 60-Hz electromagnetic fields (EMF) when he installed a personal computer in his chambers.

Only unreadable "garbage" appeared on the video display. When the system was moved to an adjoining room, the "noise" would disappear even though still powered by a long extension cord from the original receptacle.

Building maintenance personnel recalled that the service lateral (1/4 x 6-in., open bus bars) passed directly beneath the floor of the judge's chambers.

Personnel from the Public Service Company of Colorado (PSC) were summoned to "map" the field strength levels in the judge's chambers and adjacent offices to confirm suspicions.

An Electric Power Research Institute STAR gaussmeter mounted on a frame measured the field strength 30 in. above the floor. A measuring wheel automatically accumulated the distance traveled from the starting point.

The three-coil meter reads the "resultant" of the field strengths in the x-y-z planes. The route traveled passed over the bus bars several times as the instrument was routed around office furniture.

As was discovered later, the readings in the 400-500 milligauss range (which occurred near the beginning of the measurement route) were being created by fields emanating from yet another source—unconfined cables which added to the fields being generated from the open bus bars.

Possible solutions

Stone and Webster Engineering Corp., was given the assignment of developing possible solutions for reducing EMF. With assistance from technicians from PSC, a series of experiments were investigated including:

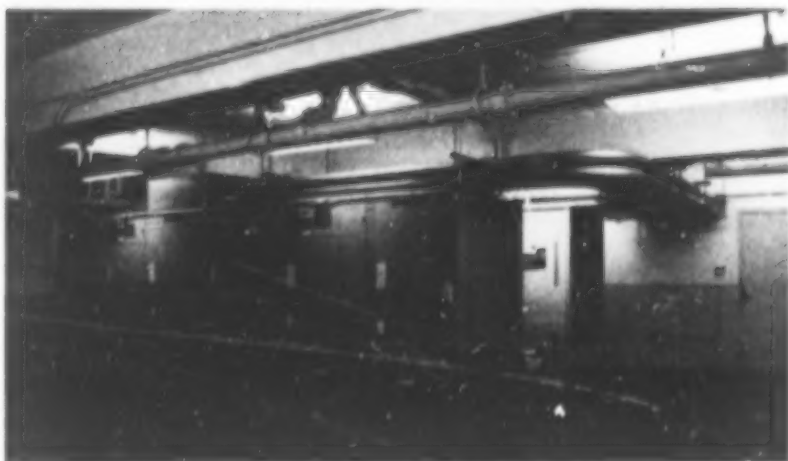
- The bus bars were originally protected by a sheet-metal shroud on three sides, but were unprotected on the top. A sheet of metal was carefully maneuvered over the bus bars to create a complete, metallic enclosure around the bars thereby providing a short-circuit (or at least a lower-reluctance path) for the induced fields. Surprisingly, measurements within the judge's chambers revealed little attenuation.

- Next, two, 1/2-in. thick, steel plates, four ft² were placed directly over the bus bars on the floor of the judge's office. The result was deformation of the fields but no attenuation in the areas of interest.

- The plates were then grounded by a heavy welding cable to a nearby cold-water pipe resulting in only a slight attenuation over the initial, ungrounded configuration.

Up to this point, effort was being concentrated on fields emanating from the open bus bars. We began to suspect that other sources of high EMF might exist. Using a single-coil gaussmeter (Electric Field Measurement Co., Model 112 Dinometer, other room surfaces were explored. Along the north wall, which separates the judge's office from the transformer vault, readings in the order of two gauss were recorded near the floor.

A tour of the interior of the transformer vault revealed the source of these high levels. From the collector buses over the three, 1000-kVA network transformers, sixteen parallel runs of four, 500-MCM cables (eight parallel runs to each switchboard bus) were bundled on a cable tray attached to the wall. These cable groups were right at floor level of the judge's office and parallel to the long dimension of



Each switchboard accommodates 11 conduits and a "top hat" above. The adjacent transformer vault houses 88 cable terminations. The new arrangement virtually eliminated the EMF problem.

the room. Readings as high as nine gauss were registered in the immediate vicinity of the cable groups within the transformer room.

Stone and Webster considered several alternatives for confining the fields from the cable groups and the open bus bars. None appeared to offer real promise and most would have involved inordinate costs or lengthy outages for the facility—situations which were unacceptable.

The problem was discussed with Frank Barnes, professor, Electrical and Computer Engineering Department, University of Colorado—an acknowledged expert on EMF.

Experiments by Barnes and Jackson Fuller, retired professor of electrical engineering at CU, revealed that EMF could be reduced in the order of 100 to 1 around wire in free air and wire confined in steel conduit.

Stone and Webster conceived a re-design of the service lateral into the City and County Building which involved eliminating the open bus bars and replacing them with cable in conduit. The three phase conductors and full-sized neutral in each conduit would be "twisted" (transposed) as they were pulled into the conduit, creating an even further cancellation of EMF.

The conduits were to be routed as far away as possible from the judge's desk to gain advantages of attenuation with distance. Finally, the conduits would be terminated at the switchgear (top fed) in heavy, steel enclosures to further confine fields at the terminus of the conductors.

Beginning at 6:00 PM on a Friday evening, all power was removed. Critical circuits were powered by an emergency generator which also provided construction power.

Busbars between the transformer vault and switchboard were removed and busbar extensions were fabricated and drilled for 88 terminations. These extensions were made to match the original bolt pattern in the switchboard buses, thus preserving the "original configuration" of the switchboards as "U.L. labeled" at the factory.

Some 88 cable terminations and splices were made at both the switchboards and the transformer vault. PSC's metering instrument transformers were relocated, reconnected and recalibrated.

The three, remaining sides of the heavy, steel "top hats" were placed and secured and the fire rating of the wall between the switchgear room and the transformer vault was re-established by closing the former openings for the bus bars.

Some 44 hr later, normal power was restored to the facility without any unfavorable incidents. After all modification activities were completed, another

EMF strength map showed dramatic reductions. The high point, again, appears near the beginning of the measurement route—undoubtedly because of its proximity to the collector buses in the transformer vault and the 88, unconfined "pigtailed".

Lessons learned

Several lessons were learned and several design considerations surfaced during this case study including:

- Extra-low-frequency (ELF) electromagnetic fields, of levels capable of

causing erratic performance in electronic equipment, will exist in an office environment where high-current levels exist.

- Such fields can be significantly reduced without resorting to the use of expensive, high-permeability alloys.

- Routing of poorly shielded bus bars or open cables (as is commonly employed in cable tray installations) should be carefully located in relationship to areas occupied by people or sensitive electronic equipment.

- The effects of electromagnetic fields is often fraught with emotional concerns while being studied by the scientific community.

Though external, EMF were attenuated successfully, introduction of equipment which generates extra-low-frequency (ELF) electromagnetic fields within the "conditioned" space will, itself, become a source of concern.

Best practice

Until the scientific community is able to "quantify" levels and durations of exposures which are not injurious to human health, the policy of "prudent avoidance" is, perhaps, the best practice for electrical distribution systems in commercial buildings. Prudent avoidance is defined as taking those actions which can reasonably be accomplished to mitigate the effects of extra-low-frequency electromagnetic fields whether they be accomplished by shielding or distance.

DA/LM spending holds steady

ROSEVILLE, CA—U.S. and Canadian utilities will spend \$326.8 million on distribution automation (DA) and load management (LM) systems in the 30-month period from July, 1992-January, 1995, according to market researcher CSR Inc.'s latest study.

A decrease in spending for DA projects from \$81,595,000 in 1991 to \$63,622,000 in 1992 was offset by a dramatic rise in remote terminal unit (RTU) add-on projects from last year's figures.

Plans for design, development, and purchase of a new or upgraded DA and LM systems include:

Project Type	# of Projects	\$ (000)
DA	182	\$63,637
RTU Add-On	76	60,292
LM	126	87,816
Switch Add-On	176	115,031

CSR's survey of 1462 utilities also found an increase in the number of switches being purchased for both LM and switch add-on projects indicating an increased interest in demand-side management.

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